Conclusions.—(1) Operative successes occur in cases of moderate or extreme ascites in the very cases which so commonly recover under medical treatment.

(2) There is little difference in the mortality of the cases whether operation is resorted to or not. Such slight difference as does occur is in favor of operation.

(3) No harm seems to have occurred from the operation, and even in the most gloomy and hopeless cases some degree of improvement seems due to the operation.

(4) Such merit as may be allowed the surgical treatment lies (*a*) in a more prompt and complete removal of fluid than is usually practiced in the medical wards, and (*b*) the removal of larger masses of lymph and caseous products.

(5) The washing out of the abdominal cavity with germicidal solutions is not only futile but wrong in principle. König found in 131 cases that the mortality was greater with irrigation than without.

WILLIAM B. COLEY.

HAEGLER ON THE SURGICAL SIGNIFICANCE OF DUST.[1]

THE author states that the doctrine of air infection has gone through many phases. Since Lister endeavored to protect wounds from the air by his first antiseptic dressing, since the time when the smallest operation was not undertaken without "disinfecting" the atmosphere with the spray, the air has been held accountable for many sins of omission, and has had to account for many misconceptions, until the gradually perfected technique of antisepsis, and later the surprising results of asepsis, placed the doctrine of air infection on a broader basis. With the aid of bacteriology, many of the features of the technique of Lister have been done away with. This progress is characterized in that the mystical and fatalistic doctrine of the all-domineering air infection has had to make room for the more real knowledge of contact infection. It was learned to hold the operator and assistants, the fingers and instruments and everything

[1] Beiträge, zur klinischen Chirurgie, Band IX, Heft 3.

which came in contact with the wound accountable for wound infection. Air infection has been relegated to the domain of the phantoms.

The author has endeavored, by a series of experiments, to decide whether this question of air infection shall be rightfully thrown entirely out of consideration. The experiments were made in the surgical clinic of Prof. Socin, in Basel.

After the development of erysipelas in one of the hospital wards, in which no erysipelas had occurred for more than eighteen months, the first experiments were made: The entire room was evacuated, and the bacteriological examination of the air conducted with gelatine and agar on Petri's plates. The exposures were made under three different conditions: (1) An hour after any one had been in the room, and when everything was as quiet as possible; (2) while several persons were moving about in the room; (3) while the floor was being swept dry with a broom.

Plate *a* (gelatine) was placed between the two erysipelas beds thirty centimetres above the floor; plates *b* and *c* (gelatine and agar) stood at the foot and head ends of these beds on a level with the pillows. The time of exposure was five minutes. The following results were obtained:

		Bacteria colonies.	Other fungi.
Experiment I (quiet room).	Dish *a*	4	4
	" *b*	3	1
	" *c*	2	1
Experiment II (motion in room).	Dish *a*	31	6
	" *b*	22	3
	" *c*	25	5
Experiment III (sweeping in room).	Dish *a*	238	24
	" *b*	112	38
	" *c*	164	31

On these plates were discovered as follows:

Plate II. (*a*) Two colonies of staphylococcus pyogenes aureus; (*b*) one colony of staphylococcus pyogenes albus, two colonies of streptococcus pyogenes.

Plate III. (*a*) Three colonies of staphylococcus pyogenes aureus; (*b*) four colonies of streptococcus pyogenes, nine colonies of staphylococcus pyogenes aureus.

The staphylococci were identified by cultures in the various nutrient media and by animal inoculations. By the inoculation of rabbits from four different cultures, subcutaneous abscesses were caused in two cases. In one case the animal perished from general sepsis. The abscess pus gave pure cultures of staphylococcus pyogenes aureus. The streptococci were identified in the same manner. Inoculation of a rabbit's ear from an agar culture by a simple prick caused, in three out of five cases, a circumscribed reddening and infiltration. The question as to whether the streptococcus pyogenes is identical with the streptococcus erysipelatis or not, which has been decided in the positive by the majority of observers, had in this case no great importance. It was of consequence, however, that in the dust in the air of a sick-room pathogenic staphylococci and streptococci were discovered whose vitality could be demonstrated by cultures, and the pathogenic character of which was proven by animal experimentation. Among the 601 bacteria colonies, were at least twenty-one pyogenic colonies—fifteen staphylococci and six streptococci.

These bacteria have been repeatedly demonstrated in the air, or in its dust. The streptococcus erysipelatis has been cultivated by von Eiselberg[1] from the air of a sick-room, and by Emmerich[1] from the air of a dissecting room. The pyogenic staphylococci were found in the air of sick-rooms and operating rooms by Neumann,[1] von Eiselberg,[1] Welz[1], Ullmann,[1] Pawlowsky, and in the air of dwellings and stables by Karlinsky,[2] C. Fraenkel[3] and Uffelmann.[1]

In connection with this question of infection from the air, the following investigations arise: Where, and under what circumstances, do these germs occur in the air of the rooms of our surgical pavilions?

[1] Vide Litteraturverzeichniss.

[2] Przeglad Lekarskie, 1888. Ref. in Jaresb. v. Baumgarten, 1889.

[3] Grundriss der Bacterienkunde, S. 318.

Under what circumstances is their number increased? Is their number greater in the surgical wards than in the other sick rooms of our hospitals, or in rooms in which no patients are confined? How is this air-infection to be prevented? How is its danger to be lessened?

The whole question rests, not in the examination of the air, but in the examination of the dust which is precipitated out of the air. Tyndall[1] has observed that atmosphere which is free from dust, "optically pure," in the electric light, contains no germs. According to Hesse and Petri, the bacteria are not suspended in the air separately and individually, but either as groups of individuals or upon vehicles such as coarse particles of dust. In all of these investigations, the terms "air" and "dust" have been employed too synonymously. In an unclean room, which is perfectly quiet, the number of germs in the atmosphere is less than in a relatively clean room in which the atmosphere is in a state of commotion. It is only the dust, therefore, which is held in the air that comes into consideration. From the fact that these particles are governed by the laws of gravity, the strata of air nearest the floor in a closed room contains more germs than the higher strata.

In these experiments the dishes of Petri were employed, covered with 10 per cent. nutrient gelatine, after the method of Koch. Examinations of the dust in the air of sick rooms, operation rooms and other closed rooms were made. The hair of the beard and head, and operating coats were, after exposure to the dust in the air, subjected to examination for bacteria. Cobwebs in the corners and niches of the surgical clinic and operating-room were also investigated. In all of these, abundant colonies of mould fungi and bacteria were discovered, especially staphylococci and streptococci.

When the circumstances under which these germs gain access to the air are considered, a multitude of sources are discovered. Suppurating wounds are by no means the necessary source of these germs. Staphylococci and streptococci are found in the normal saliva,[2] and

[1] Medical Times and Gazette, 1870; Naturforscher, 1870, Nr. 13.

[2] Biondi, Zeitschrift für Hyg., II., S. 225; La Riform. Med., 1886, Nr. 3; B. Fränkel, Berliner Klin. Wochenschr., 1886, 17 u. 18.

nasal mucus,[1] from which they are disseminated by expectoration, sneezing, etc. They are found on the surface of the body,[2] in the normal urethra,[3] in fæces,[4] from which they enter the clothing and vessels, become dried, and are liberated as dust. From the dirt beneath the nails[5] they are transmitted to utensils and food. They exist in the earth,[6] and are brought into the clinic on the shoes.

In still greater numbers are these germs mixed with the air by suppurative processes, operations for the liberating of pus, and the dressing of suppurating wounds. Since the dry treatment of wounds has come into vogue, and the wet dressings have been discarded, during the process of dressing, more germs are thrown off with the dust. In the dry dressings of pus-containing wounds, the pus becomes dried and encrusted; and in cutting or bending these dressings, fine particles of desiccated pus are thrown off into the air. If the dressings after their removal are allowed to lie about and be handled in a dry state, still more of the desiccated matter mingles with the dust of the atmosphere. Fortunately these germs in the air perish very rapidly.

The only publication concerning their longevity in a dried state is that of Passet. They were taken from pure cultures and dried upon cover-glasses. At the end of ten days they were still capable of reproduction. The investigation was not carried further than this. Haegler has, therefore, proceeded to continue investigation in this line. The experiments were carried on in such a manner as to imitate the natural conditions as much as possible. Various sorts of pus were dried in pieces of sterilized mull-cloth at room temperature and preserved in sterile glass dishes. After properly drying, which was accomplished at a temperature of 17–20° C., in ten to twenty-two

[1] Bockhardt, Monatshefte für prakt. Dermatologie, IV, 1887, Nr. 10.

[2] Travel, Korrespondenzblatt für Schw. Aerzte, 1892, Nr. 13 u. 14.

[3] Austgarten u. Mannaberq, Vierteljahrsschr. für Dermat. und Syphilis, 1887.

[4] Münchner Med. Wochenschrift, 1886, Nr. 51 u. 52.

[5] Fürbringer, Untersuchungen und Vorschriften über die Disinfection, etc., Wiesbaden, 1888, Bergmann.

[6] Sübbert, Biolog. Spaltpilzuntersuchungen; der Staph. pyog. aur., Wurzb., 1886, Stahel.

hours, small portions of the crusts were rubbed to a powder and placed in sterile glass dishes.

The investigations of the vitality of these preparations were at first made every other day; then every fourth day; after two weeks they were made weekly; and after four weeks every fourteen days, in the following manner:

(1) From the pulverized pus dust small quantities were blown into the air in such a way as to fall on Petri's dishes covered with gelatine and agar.

(2) Small pieces of the impregnated mull were cut out with sterilized scissors and placed in bouillon, and on gelatine and agar plates.

Four of the specimens of pus used in the experiments originated as follows:

(1) Abscess of an axillary lymph nodule. Thick, slimy, reddish pus. Staphylococcus pyogenes aureus.

(2) Large carbuncle on the nape. Thick, yellow pus. Staphylococcus pyogenes aurens and albus.

(3) Strumitis in a case of pyæmia. Thin, yellowish-green pus. Streptococcus pyogenes.

(4) Deep abscess of the neck. Thin, yellow pus. Streptococcus pyogenes.

The streptococci from case 4 perished the soonest. After ten days but a very few of the germs were alive. After fourteen days no development followed their implantation on gelatine or agar plates, but in bouillon, at breeding temperature, the pieces of mull cloth developed colonies. After twenty-eight days all of the attempts at cultivation were fruitless. The streptococci from case 3 survived somewhat longer. After fourteen days agar plates, on which the pus dust fell, showed an immense number of colonies, while on gelatine they were very few. After twenty-eight days no cultures could be made on either gelatine or agar; but in bouillon growths went on after thirty-six days. After forty-two days no further development could be demonstrated.

The staphylococci showed in the dry state a greater tenacity. The material from the axillary abscess was pulverized and also dried on mull; and after thirty-five days still retained its normal vitality. Here also growth could be last demonstrated in bouillon; for after fifty-six days attempts to make cultures on agar and gelatine were sterile, but development could be demonstrated in bouillon. At the end of seventy days all attempts at culture were fruitless.

Of all the bacteria the staphylococci from the carbuncle (II) showed the greatest vitality. Those in the pulverized pus were capable of propagating after seventy days, and those dried in the mull cloth retained their vitality after eighty-four and 100 days.

In the four varieties of pus investigated the streptococci retained their vitality in dried material fourteen to thirty-six days, and the staphylococci fifty-six to 100 days.

If spore formation is not observed in cocci the question of their great vital tenacity must be considered. The pus itself forms a slimy, dense, gelatinous covering around the dried germs, which tends to protect them; and it is possibly for this reason that germs in thick pus retain their vitality longer than those occurring in pus in thin consistency. In finely pulverized material the germs perished much quicker than in the crusts, a millimeter of which was dried on the pieces of cloth. Nevertheless they retain their vitality tolerably long even in the form of dust.

It is noteworthy that in bouillon[1] the vitality of these bacteria could be last demonstrated. This is readily explained by the fact that the slimy covering, dried about the germs, is softened and dissolved by the fluid nutrient medium at the breeding temperature, and that a fluid medium is best adapted to completely envelop these particles.

Lastly, these few experiments show that the source of the pus plays an important rôle in the tenacity of the germs.

In view of such vital tenacity in a dried state, the dissemination

[1] Fleischwasserpeptonnährbouillon. Löffler's method with 5 per cent. grape sugar.

of pyogenic cocci in the air is not to be wondered at. The fact of their presence, however, is not always of the same importance. Schimmelbusch reckoned that on a wound of one square decimeter, exposed for half an hour in the clinic, sixty to seventy germs would fall; whereas this wound, if the patient were washed with a liter of Spree water, would come in contact with thirty-seven million of bacteria. This example does not by any means show that the so-called air infection is a *quantité négligable*. It is a very different thing when thirty-seven million germs — mostly non-pathogenic — are washed through a wound, and when a few pathogenic bacteria fall into a wound and are rubbed in with dry sponge material and become adherent.

This "air infection" can really become a "contact infection," and this is perhaps most frequently the case. The important thing is not simply the falling of the germs upon the wound surface; for if the wound were not disturbed, and remained absolutely quiet, the dangers of infection would be almost null, because the germs would either be washed away by the blood or lymph or rendered harmless.

The supposed germ, however, falls into the wound from the air in the dust, or from the hair of the operator and assistants, or from the operating gowns. It is now rubbed in with the instruments, or, what is still more plausible, pressed into the tissue or lymph-stomata with the dry sponge material; and here its development must needs give rise to disturbance. The drying of the wound by perfect hæmostasis, and the use of dry and hydroscopic sponge material, furthers the possibility of this hypothetical air infection.

It may be argued that a single germ can not hold out in the strife against blood serum or cells, or that a single germ is not enough to cause an infection. To the first it may be replied that perhaps the very pressing in of the germ and the wound of the tissues so lowers their natural resisting power as to afford a favorable nidus for germ growth. In an operation wound, even when made with the sharpest knife, the vital energies of the tissues are much reduced, and countless smaller wounds are made by pinching with clamps, forceps,

etc. To the second argument it may be replied that the germ particles of the dust in the air are very rarely a single individual,[1] but are composed of a conglomeration of a greater or lesser number of germs which are found on the larger particles of dust. Of course, it can not be ascertained how many of these germs go to make a colony on the culture plate.

It is not known whether single individuals are capable or not of causing a local or general infection. But when the enormous rate of multiplication of bacteria is taken into consideration, it is clear enough how a few or a group of germs, when planted where they meet with no resistance in a favorable soil, can increase so rapidly as to soon give rise to pronounced pathological phenomena.

It cannot be said that in every case of wound infection some evident local disturbance must follow in the course of a few days. Such sequelæ belong only to the more severe cases of infection. A slight elevation of temperature may indicate an abortive general infection; and a slight redness of the edges of the wound, disappearing after a few days, pain in the wound, etc., are the signs of a local infection which has been overcome without further disturbances. It simply means that the organism has won the upper hand over the bacterial invasion. Does not infection take place slowly and in immeasurable stages? Is not the first thing observed really the last stages—suppuration and severe general disturbances? Under what circumstances does infection generally occur?

These and many others are open questions, and our knowledge of these vital things is so incomplete that such questions will, perhaps, for a long time remain unsolved. It remains again to be emphasized that, notwithstanding the richness in germs of the air of our sick rooms and operating theatres, an infection from this source is but a small factor in the number of dangers of wound infection. Still, it is a factor which must always be taken into account.

Finally, two sets of rules may be laid down as conclusions from the above observations: (1) those which shall hinder the harmful

[1] Hesse and Petri. L. c.

effects of the dust or eliminate it, and (2) those which shall prevent the conversion of infectious material into dust.

(1) The dangers of wound infection from the dust in the air are the greatest in the operating room, because there the most wounds are opened for the deposit of dust, and there the wounds are in a fresh state and not protected by granulations.

The spray which was first used to combat these dangers has passed into desuetude. The moistening of the air by means of steam or spray was next employed, and it was found that an air laden with moisture contained fewer germs than dry air. This is because the germs suspended in the air are carried to the floor by the drops of water, and because the dampness of the floor prevents more dust from arising. Fischer observed that the air at sea 120 miles from the land was free from germs. The artificial induction of dampness of the air is worthy of consideration, and in this line Haegler has carried out a series of experiments. Repeated observations were made by exposing culture plates in the operating room when the air was dampened by a cloud of steam, and comparing the results with those obtained in the dry air. The experiments showed decidedly that in closed rooms the thorough moistening of the air has a purifying effect just as has the rain out of doors. Mikulicz drew a comparison between the spray and the rain; and to show the harmful effect of the former, he said that "every housewife in the country knows that the first rain water soon begins to putrefy," because the rain carries down out of the air a great many germs. Rydygier observed that only the first rain water was thus prone to become putrid, and that the following was just so much freer from germs. He also stated that the spray may be employed to advantage if it is put in operation for some time before the operation is begun. And after his elaborate series of experiments it may be concluded that a thorough dampening of the air with steam removes almost completely, in a very short time, all of the germs; and by a moistening of the floor, walls and apparatus in the room the further formation of dust is prevented.

The time required in precipitating the bacteria from the air

varies with the intensity of the steam. If the room can be filled with steam from the steam pipes in a very short time the air can be quickly purified. It is not a question of antisepsis or of the Listerian spray, but a simple moistening of the air. The idea that infection of the air of a closed room can come from the expired air of the operators and spectators has met with abundant refutation.

(2) The principles which shall prevent the infectious materials from being converted into dust are especially worthy of consideration.

The most important source of infection in sick rooms is the dust, and especially that which lies loosely on the floor, walls and furniture, and waits for a slight motion of the air to pick it up and carry it away.

Before the removal of a dressing the greatest amount of quiet should have prevailed. Everything required in the operation should have been arranged. Especial care must be taken in removing dry dressings from infected wounds, for it must be borne in mind that there is danger of disseminating infectious material into the environs. The incrusted pus may be dampened, and this also makes the removal of the dressing easier for the patient.

If the dressings and sponge materials are thrown into open vessels or pus basins, and allowed for a time to lie about, the pulverization of infectious material is encouraged. It is best, therefore, to place the dressings in a closed receptacle, the bottom of which is covered with an antiseptic or aseptic solution. Later, the materials should be burned.

If possible, when a wound in a ward becomes infected, the patient should be removed from the aseptic department to some room for the purpose of isolation of infected wounds. This is a principle which has already become quite generally accepted.

In the morning, before the patients arise, the dust, which has had a chance to settle during the night, should be mopped up from the floor, furniture, and possibly from the walls, with a wet cloth. Parquet floors are not injured by this frequent dampening. They should be oiled weekly with a mixture of turpentine and petroleum in equal parts.

In the operating room, the above principles are of the greatest importance. Above all, the dust on the floor, wall, etc., is to be regarded as a source of infection. The dissemination of this dust can be, in a measure, prevented by the use of steam: that is, by dampening the whole interior surface of the room. The operator and assistants should also give careful attention to the hair and beards. They should be either wet or oiled. The operating gowns should be moistened. This is usually accomplished in the sterilizer.

The above procedures may seem complicated and difficult, but this is not the case. They demand no great expenditure of time or material, but only a little more care.

JAMES P. WARBASSE.

POSTNIKOW ON GASTROENTEROSTOMY IN TWO STAGES.[1]

IN the year 1881, A. Wölfer published a paper on the subject of establishing a fistula between the stomach and intestine, gastroenterostomy, which he had been the first to accomplish.[2] It was in the case of an inoperable, stenosing, carcinoma of the pylorus. Since then more than ten years have passed; but, although there are plenty of opportunities for performing the operation, the indications for the same have ever remained limited. It seems that, in more recent times, the tendency is growing stronger to discard the dangerous operation of pylorectomy for carcinoma pylori, excepting in distinctly operable cases, and to give the preference to the gastroenterostomy. This seems to be justified by the very much lesser mortality of the gastroenterostomy.

In the endeavor to lessen the death rate, and to reduce, as much as possible, the danger of this valuable palliative measure, Postnikow has performed a series of experiments upon dogs, with the view of proposing certain modifications in the carrying out of the operation.

[1] Centralblatt für Chirurgie. No. 49, 1892.

[2] Centralblatt für Chirurgie. No. 45, 1881.